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OPERATOR'S MANUAL

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.

MODELS 2850 and 2851
3-1/2 DIGIT PANEL INSTRUMENTS

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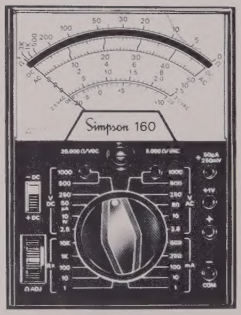

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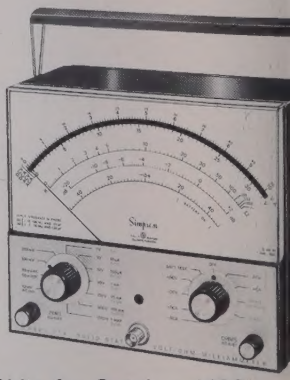

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OPERATOR'S MANUAL

MODELS 2850 and 2851 3-1/2 DIGIT PANEL INSTRUMENTS

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In Canada, Bach-Simpson, Ltd., London, Ontario

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Figure 1-1. Models 2850 and 2851, Digital Panel Instruments

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WARNING

The 2850 and 2851 are designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

NOTE: The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229-Series 2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC Leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

SECTION I

INTRODUCTION

1.1 GENERAL

1.1.1 The Models 2850 and 2851 shown in Figure 1-1 (hereafter referred to as the Models 2850 and 2851, or simply as the Instruments), are 3-1/2 digit, panel-mounted instruments that provide both visual indication and data recording outputs for either DC voltage or DC current measurement. Both Models feature 0.1% accuracy using solid-state integrated circuit electronics. For general applications, the Model 2850 can be used as a self-contained, panel-mounted unit, operating from either a 120 or 240 volt AC, 50 to 400 Hz power source. The Model 2851 is equally suitable for various mounting configurations and it is designed to operate from a 5 VDC power source (check label on top of case). Additional features include 0.55 inch planar gas-discharge display, automatic polarity selection and indication, automatic zeroing, excellent temperature characteristics, up to 100 megohm input resistance (for DC voltage models), fast response time, and 100% overranging capability with automatic out-of-range indication.

1.1.2 The Models 2850 and 2851 are designed to measure DC voltage and DC current as specified in Table 1-1. The entire analog-to-digital converter circuitry is contained in two Large-Scale-Integration (LSI) modules. The LSI's used in these Instruments provide high reliability and compact design.

1.1.3 Both Models (2850 and 2851) are especially suited for system-oriented applications. The versatility of AC line or DC operation and 200 mV full range sensitivity allows the Instruments to be used as a direct replacement for an analog type panel instrument. This feature makes it convenient to convert existing instruments or systems from analog to digital display and at the same time improves the performance of the system. The Models 2850 and 2851 provide BCD outputs in a parallel bit, serial digit format.

1.1.4 The internal packaging of the Model 2850 consists of two printed circuit (PC) boards. These are the analog-to-digital (A/D) converter board and a digital display board. The Model 2851 has the same two boards as the Model 2850 plus a DC-to-DC converter board, which is used to provide the necessary operating voltages.

1.1.5 The 3-1/2 digit numeric display used in these Instruments is a gas-discharge planar 7-segment type, with 0.55" high characters. The combination assures easy viewing of the display from a distance and at wide angles. Ambient lighting effects are minimized by a polarized filter that reduces reflections and background illumination.

1.1.6 The Models 2850 and 2851 are each available in nine configurations: Four DC voltage ranges, and five DC current ranges, each with 0.1% measurement accuracy as shown in Table 1-1. The Instruments are designed to use a popular dual 15-pin (female) PC edge connector for making all input and output connections to and from the Instruments. Recommended connectors are listed in Table 3-1. The connector can be ordered as an option.

1.1.7 A pair of side brackets are supplied with each Instrument to facilitate mounting to a panel cut-out. If minimum side space is a requirement, a "U" bracket is available as an option.

1.2 PC CONNECTOR AND PANEL MOUNTING OPTIONS

An optional PC board connector is available for all input and output connections. The three panel mounting options adapt the Models 2850 and 2851 to cut-out dimensions in accordance with IEC (International Electrotechnical Commission), DIN (German Industrial Norms) and popular domestic sizes.

a. Catalog No. 22990 PC board connector. Use this item for all input and output connections to simplify installation.

b. Catalog No. 22992 is an IEC, DIN panel mounting adapter. Use this kit for mounting Models 2850 and 2851 in IEC or DIN panel cut-outs, which are 92 x 45 mm.

c. Catalog No. 22993 domestic panel adaptor (fits popular domestic cut-outs). Use this kit when the existing cut-out dimensions are 1.682 x 3.920 in. (99.57 x 42.72 mm).

d. Catalog No. 22991 IEC, DIN rear mounting bracket. Use this kit in addition to Catalog No. 22992 when the application must meet the maximum allowable width dimensions of the IEC or DIN standards, or when minimum side space is required.

1.3 TECHNICAL DATA

Table 1-1 lists the technical data for both Models 2850 and 2851.

Table 1-1. Technical Data

1. FULL SCALE RANGES:

DC Voltage:

Range	Maximum Indication	Input Resistance	Overload Protection	Catalog Numbers Model 2850	Model 2851
200mV	±199.9mV	≥100MΩ	350V	22984	24101
2V	±1.999V	≥100MΩ	350V	22976	24102
20V	±19.99V	10MΩ	350V	22977	24103
200V	±199.9V	10MΩ	350V	22978	24104

DC Current:

Range	Maximum Indication	Voltage Drop	Maximum Input Current	Catalog Numbers Model 2850	Model 2851
20μA	±19.99μA	200mV	20mA	22979	24105
200μA	±199.9μA	200mV	20mA	22980	24106
2mA	±1.999mA	200mV	20mA	22981	24107
20mA	±19.99mA	200mV	100mA	22982	24108
200mA	±199.9mA	200mV	1A	22983	24109

2. ACCURACY: ±(0.1% of reading +1digit), from +15°C to +35°C.

3. TEMPERATURE COEFFICIENT:	±(0.01% of reading + 0.05 digit) per °C, from 0°C to +55°C.
4. SENSITIVITY:	100μV for 200mV unit; 10nA for 20μA unit.
5. RESOLUTION:	1 part in 2,000.
6. INPUT BIAS CURRENT:	40pA maximum at reference conditions (see item 16).
7. FULL RANGE STEP RESPONSE: (to rated accuracy)	Less than 800 milliseconds.
8. NORMAL MODE REJECTION:	55 dB minimum at 60 Hz.
9. COMMON MODE REJECTION: (with 1kΩ unbalance at 60 Hz)	Model 2850: 90 dB minimum Model 2851: 60 dB minimum
10. RATED CIRCUIT-TO-GROUND VOLTAGE:* (Maximum Common-Mode Voltage)	350 VDC between either input terminal and power line ground (2850) or 5 VDC terminals (2851).
11. CONVERSION:	
Technique:	Charge-Balance
Rate:	4 samples per second nominal
12. DISPLAY:	
Type:	7-segment, planar, gas-discharge with 0.55" high numerals.
Number of Digits:	3 full digits plus overrange "1" digit.
Polarity:	Automatic, with "+" or "−" indication.
Out-of-Range:	All digits blink.
Decimal Point:	Fixed with range.

*The maximum voltage, with respect to ground, which may safely and continuously be applied to the circuit of an instrument.

13. POWER REQUIREMENT:

Model 2850:	120 or 240 VAC ±10%, 50Hz to 400Hz, 4 VA.
Model 2851:	5 VDC, ±5% @ 700mA.

14. TEMPERATURE RANGE:

Operating:	0°C to +55°C.
Storage:	−40°C to +60°C.

15. RELATIVE HUMIDITY: 0 to 90%, non-condensing.

16. REFERENCE CONDITIONS:

Temperature:	23°C ±2°C.
Atmospheric Pressure:	575 to 800 mmHg.
Relative Humidity:	30 to 60%.

17. WARM-UP TIME: Less than 2 minutes at reference conditions.

18. BCD OUTPUTS:

Logic Form:	C-MOS compatible, positive logic in 1-2-4-8 code. Parallel bit, serial in digit format.
Logic Levels:	"0" = 0 to +0.4 VDC "1" = +2.4 to +5.25 VDC.
Multiplex Sequence:	A1 (LSD), A3, A2, and A4 (MSD).

19. DIMENSIONS:

Instrument:	3.9" wide x 1.93" high x 4.27" deep (99 x 49 x 109 mm)
Panel Cut-Out:	3.622" x 1.68" (92 x 42.72 mm)
With Optional Adapters:	92 x 45 mm (3.606" x 1.670") DIN or IEC 99.57 x 42.72 mm (3.92" x 1.68") popular domestic

20. WEIGHT: Approximately 1 lb. (453 g)

SECTION II

INSTALLATION

2.1 UNPACKING AND INSPECTION

2.1.1 Examine the shipping carton for obvious signs of damage before unpacking. If shipping carton is in good condition, then unpack and inspect the Instrument for possible damage incurred during shipment. If damage is noted, notify the carrier and supplier and do not attempt further use of the Instrument. If the Instrument appears to be in good condition, read Operator's Manual in its entirety. Become familiar with the Instrument as instructed in the manual, then proceed to check the electrical performance as soon as possible. Also check that all items are included in the shipment (see Table 7-1).

2.1.2 Save the shipping carton and packing materials for future storage or shipment.

2.2 POWER SOURCE REQUIREMENTS

CAUTION

Do not attempt to connect the Model 2850 or 2851 to the power source until instructed to do so. Check that the power designation on top of the case agrees with the power source to be used.

The Model 2850 is wired at the factory for 120 volts AC operation (see Table 1-1). For 240 volt operation, consult your nearest Simpson representative. For proper operation, be sure that the power line ground connection of the Model 2850 is securely connected to a good earth (power line) ground. Preferably, use a standard 3-wire line cord, and a 3-wire grounded outlet that conforms to the latest electrical code. All power connections are made to the PC board connector. The power requirement of the 2850 is approximately 4 VA. The Model 2851 is wired for 5 VDC operation, requiring approximately 700 mA.

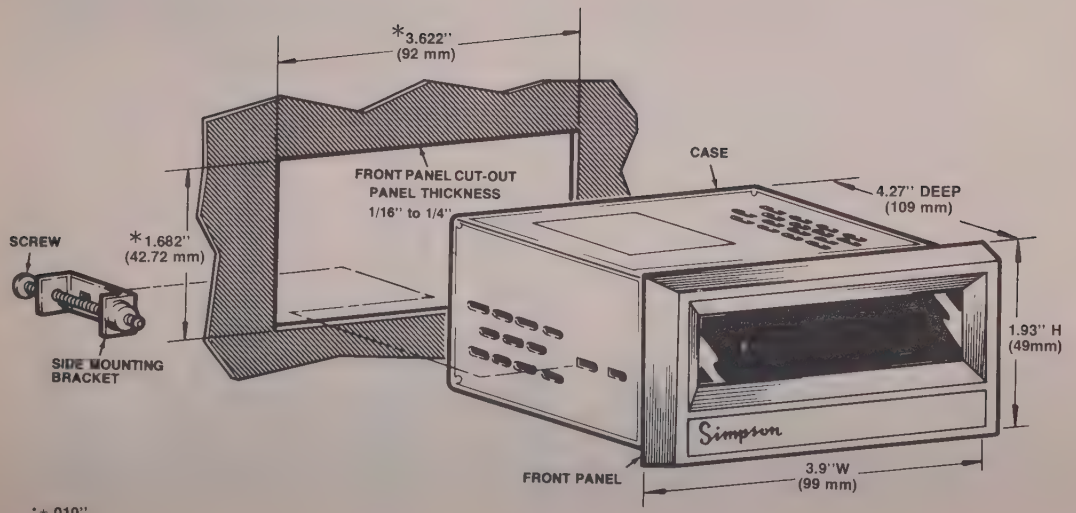

Figure 2-1. Panel Mounting and Cut-Out Dimensions

2.3 PANEL MOUNTING INSTRUCTIONS

The Models 2850 and 2851 can be mounted on panels ranging from 1/16" to 1/4" in thickness without any modification. To mount the Instrument, proceed as follows:

a. Insert the Instrument through the front panel cut-out.

b. Insert a side mounting bracket (10-863122) on each side of the Instrument. Use the two holes near the bezel as shown in Figure 2-1.

c. Slide the brackets towards rear of the slots until they lock in place.

d. Turn the screw in each bracket until the screws firmly contact the panel surface.

CAUTION

Do not tighten the screws. Wait until both screws are snug against the panel surface, then tighten the screws. Do not over tighten.

e. Refer to Table 1-1 for power requirements. Check that the power source connector is connected to the correct terminals of the PC board connector. Also be sure that the power source matches the label on the Instrument case. Refer to paragraph 4.3 for connector wiring and grounding instructions.

f. Plug in the electrical connector but do not apply power. Refer to Section IV for instructions.

2.4 PANEL MOUNTING INSTRUCTIONS (For Instruments With Optional Kits)

Adapter kits are available (see Table 7-2) so that the Models 2850 and 2851 can be used to replace instruments having a larger panel cut-out (see Figure 2-2). Two panel adapter rings are available to fit most popular sized panel cut-outs. Use the rear mounting "U" bracket (see Figure 2-3), when it is necessary to meet DIN or IEC width specifications.

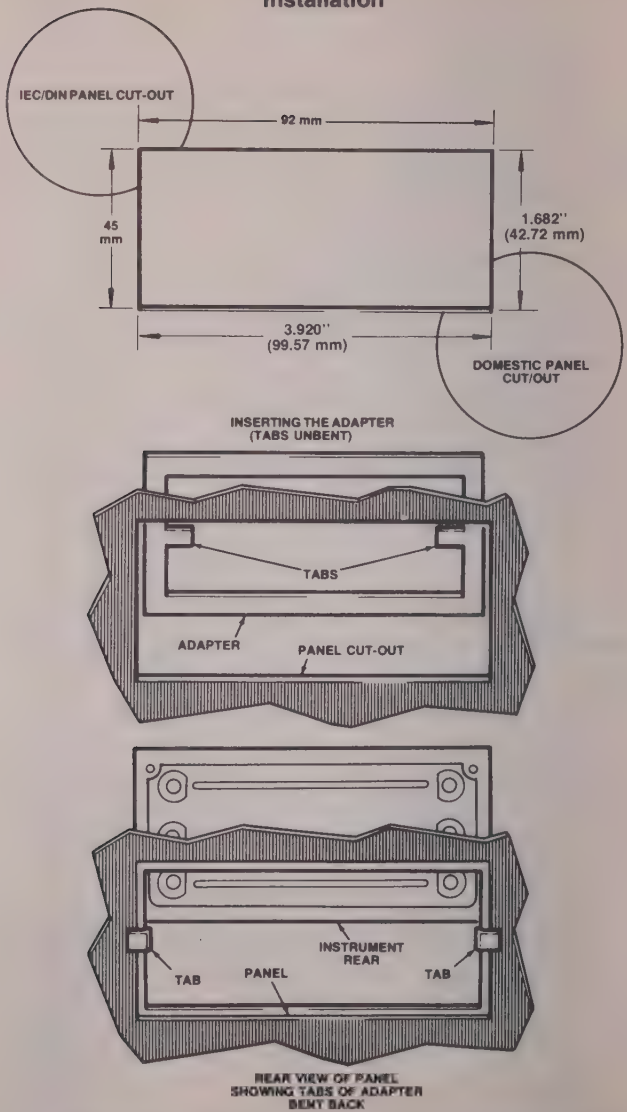

Figure 2-2. Panel Cut-Out and Adapter Ring Dimensions

2.4.1 Using the IEC, DIN adapter, Part Number 22992, when the cut-out size is 92 x 45 mm (see Figure 2-2):

a. Place the adapter ring over the panel cut-out with the mounting tabs extending through the hole.

b. While holding the adapter ring firmly against the panel, bend the mounting tabs against the rear surface of the panel.

c. The Adapter mounting ring is now secured to the front panel. Slide Instrument through hole in adapter ring and secure to panel by following mounting instructions in paragraph 2.3.

2.4.2 Using the Domestic Adapter, Part Number 22993, when the existing cut-out is 1.682 in. x 3.920 in. (99.57 x 42.72 mm) (see Figure 2-2):

a. Place the adapter ring over the panel cut-out with the mounting tabs extending through the hole.

b. While holding the adapter ring firmly against the panel, bend the mounting tabs against the rear of the panel.

c. Slide Instrument through hole in adapter ring and secure to panel by following mounting instructions in paragraph 2.3.

2.4.3 Using the rear mounting bracket, Part Number 22991 (when applications require that maximum width dimensions of IEC or DIN standards be met, use this bracket):

a. Insert the brass mounting studs (supplied with kit), into the two center holes at the rear of the Instrument. Tighten snugly.

b. Insert the Instrument through panel cut-out.

c. Slide the "U" bracket toward the panel surface until the holes in the bracket mate with the mounting studs on the rear of the Instrument. Push forward until studs extend through the holes in the brackets.

d. Place lockwasher and nut on each stud and turn until snug against bracket. Do not overtighten. Tighten nuts evenly.

e. Plug in PC board connector. Refer to paragraph 4.3 for electrical connections.

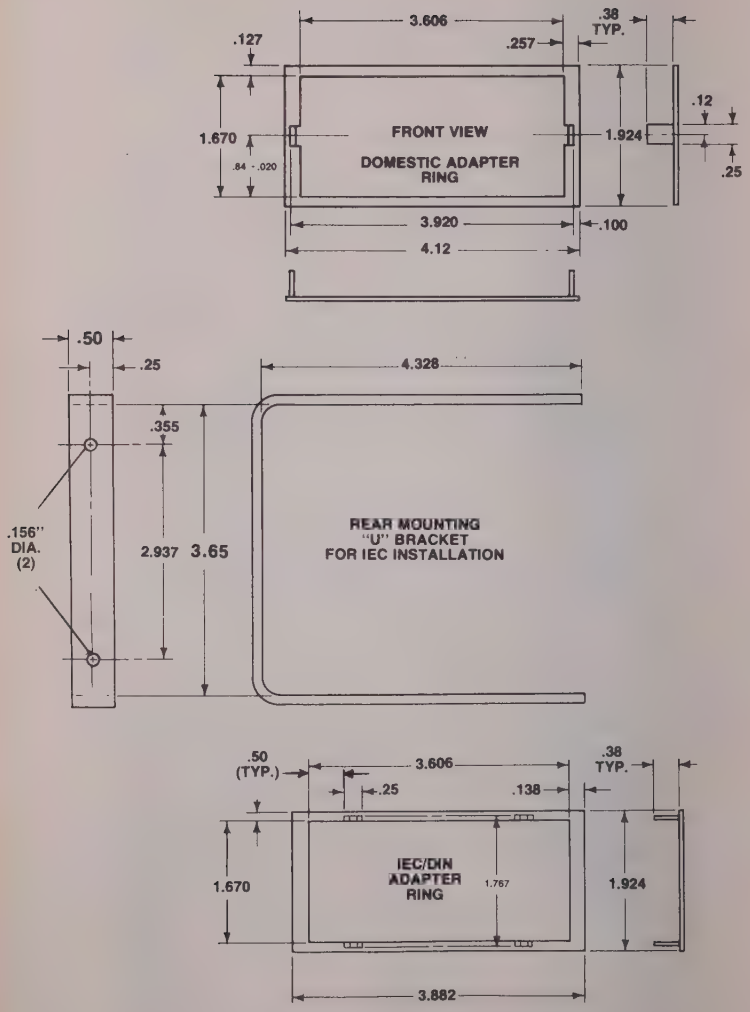

Figure 2-3. Adapter Ring Dimensions

SECTION III

CONNECTOR AND DISPLAY

3.1 GENERAL

Table 3-1 describes the connector and numeric display (see Figure 3-1) of the Models 2850 and 2851. Become thoroughly familiar with each item before operating the Instrument for the first time.

Table 3-1. Connector and Display

1. Front Panel

Numeric Display:	The numeric display consists of a polarity (+, −) sign, a "1" digit, and three 7-segment type 0 to 9 digits. The display indicates (automatically) the polarity and value of the signal being measured. When an out-of-range condition exists (greater than 1999 counts), the display flashes.

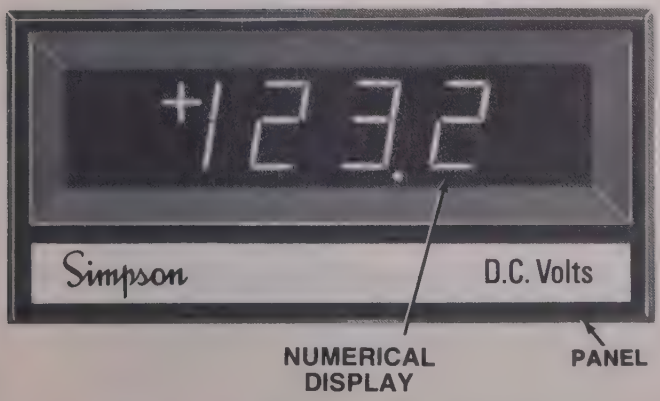

Figure 3-1. Models 2850 and 2851, Front Panel

2. Rear Panel

A/D Converter PC Board: All input and output connections are available at the contacts on the rear edge of the A/D converter PC board.

PC Board Connector: (Optional) This connector is a dual 15-pin (female) PC board edge connector (No. 22990), which plugs onto the A/D converter PC board. It provides a convenient means for making input power and signal connections to the Instrument. The contact markings and associated circuits are shown in Figure 3-3.

Recommended Sources For PC Board Connector:

a: Viking Industries Type 2VK15 D/ 1-2-34

b. VS Components Inc. Type VPCR - D15-CD

c. Amphenol Corp. Type 225-21521-101-04

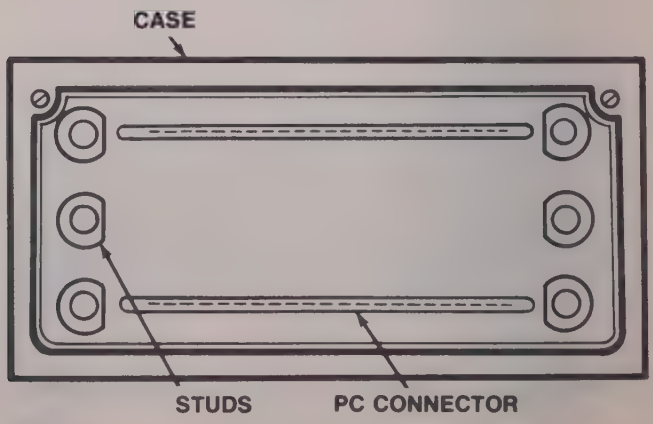

Figure 3-2. Models 2850 and 2851, Rear Panel

Connector Contact	2850 Circuit	2851 Circuit	Connector Contact	2850 Circuit	2851 Circuit
1	3rd-Wire GND	5 VDC Return	A	3rd-Wire GND	5 VDC Return
2	NC (No Connection)	NC	B	NC	NC
3	NC	NC	C	*120 VAC Low	NC
4	NC	+5 VDC	D	NC	NC
5	NC	NC	E	*120 VAC High	NC
6	NC	NC	F	NC	NC
7	NC	NC	H	NC	NC
8	A1, LSD (Multiplex)	A1, LSD (Multiplex)	J	Digital COMMON	Digital COMMON
9	A2 (Multiplex)	A2 (Multiplex)	K	B1 (BCD 1)	B1 (BCD 1)
10	A3 (Multiplex)	A3 (Multiplex)	L	B2 (BCD 2)	B2 (BCD 2)
11	A4, MSD (Multiplex)	A4, MSD (Multiplex)	M	B3 (BCD 4)	B3 (BCD 4)
12	Polarity Sign	Polarity Sign	N	B4 (BCD 8)	B4 (BCD 8)
13	NC	NC	P	"−" Input COMMON	"−" Input COMMON
14	NC	NC	R	NC	NC
15	NC	NC	S	"+" Input	"+" Input

*or 240 VAC, depending on unit ordered

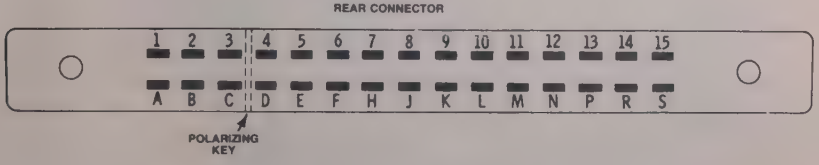

Figure 3-3. Rear Connector, Markings and Circuits

SECTION IV

CONNECTIONS AND PERFORMANCE CHECKS

4.1 GENERAL

WARNING

The Models 2850 and 2851 are designed for maximum safety to the operator when mounted in a panel according to instructions contained in paragraph 2.3. They are not intended to be used unmounted or for exploratory measurements in unknown circuits.

4.2 SAFETY PRECAUTIONS

4.2.1 The Models 2850 and 2851 do not themselves present a shock hazard, but if connected to auxiliary line operated equipment, the auxiliary circuits must be properly grounded for safety and to prevent improper readings.

4.2.2 When connecting the Model 2850 to a power line circuit, make certain that the ground terminal of the PC board is connected to earth ground as shown in Figure 4-1.

4.2.3 Do not attempt to float the input terminals at more than 350 VDC, with respect to power line (earth) ground (2850) or to the 5 VDC terminal (2851). Doing so may damage the Instrument.

4.3 CONNECTIONS AND INITIAL CHECKS

4.3.1 Model 2850 Power Connection: Check that the voltage rating on the label agrees with the source voltage to be used. Do not apply line power until all signal connections are completed.

4.3.2 Model 2850 power connections are in accordance with Figure 4-1.

4.3.3 Model 2851 power connections (5 VDC) are in accordance with Figure 4-2. Observe polarity when making these connections.

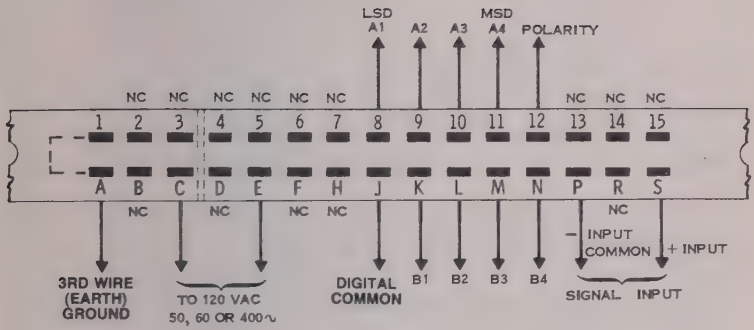

Figure 4-1. Model 2850, Connector Wiring

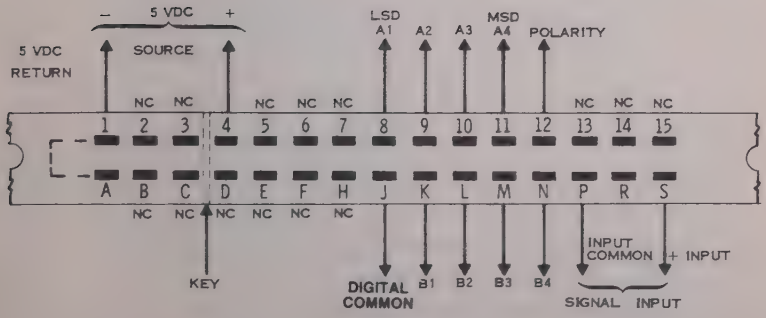

Figure 4-2. Model 2851, Connector Wiring

4.3.4 Signal input connections for the Models 2850 and 2851 are identical and in accordance with Figure 4-1 and 4-2. Use either a twisted pair of leads, or 2-wire shielded cable for low level, high output impedance circuits.

4.3.5 Offset Check

a. Orient the connector polarizing key so that it mates with the slot on the PC board and insert the PC connector onto the PC board.

NOTE: Two No. 4-40 x 5/8" screws are required to permanently attach the PC connector to the Instrument.

b. Short the signal input leads (place jumpers across terminals P and S).

c. Apply power to the instruments. For system operation of Models 2850 and 2851, turn the power switch ON to apply power to the PC connector and the circuit board. Allow a 2-minute warm-up period.

d. Check the display indication. It shall be +000 ±1 count. Decimal point indication depends on range of Instrument.

e. If difficulty is encountered, see Section VI.

4.4 PERFORMANCE CHECKS

a. **Remove power from the Instrument.**

b. Remove the short circuit from the input terminals P and S.

c. With the test voltage (or current) source turned OFF, connect the test voltage to terminals P and S, observing polarity.

d. Apply power to the instrument and the test voltage or current source.

e. Adjust the test voltage or current to values of interest and observe values indicated by the instrument.

f. If not within specifications, refer to paragraph 6.9.

SECTION V
THEORY OF OPERATION

5.1 OVERALL SYSTEM

5.1.1 The basic block diagram of the Model 2850 and 2851 is shown in Figure 5-1. The analog-to-digital conversion is accomplished by the quantized Charge-Balance technique. All A/D conversion circuitry are contained in two LSI integrated circuits. An Auto-Zero circuit minimizes the effects of offset and drift for greater accuracy.

5.1.2 The Instrument converts an analog DC voltage at the input terminals into a corresponding digital value and polarity which are displayed in numeric form on the 7-segment planar gas-discharge display.

5.1.3 The inputs to the 200 mV or 2V full range instrument are connected to the input amplifier. The remaining DC voltage ranges are either the 200 mV or 2V (2000 counts) instruments with an appropriate attenuator in the input circuits. The DC current instruments are 200 mV full range (2000 counts) devices, with a precision shunt resistor across the input. The value of the shunt resistor varies depending on the current range of the Instrument.

5.2 OPERATION (Refer to Figure 5-1)

5.2.1 Time Base Counter

An external clock signal drives a two phase clock generator. The clock frequency is divided by the time base counter into sampling intervals of 6144 pulses of which 4096 constitutes the measurement interval and 2048 for the Auto-Zero interval.

5.2.2 Auto-Zero Interval

During the Auto-Zero interval the input amplifier is switched to circuit common. A pulsed Reference Current is supplied to the integrator/comparator by the control logic circuit. The Auto-Zero circuit equalizes the input to the integrator/comparator and maintains the equalizing current during the measurement interval.

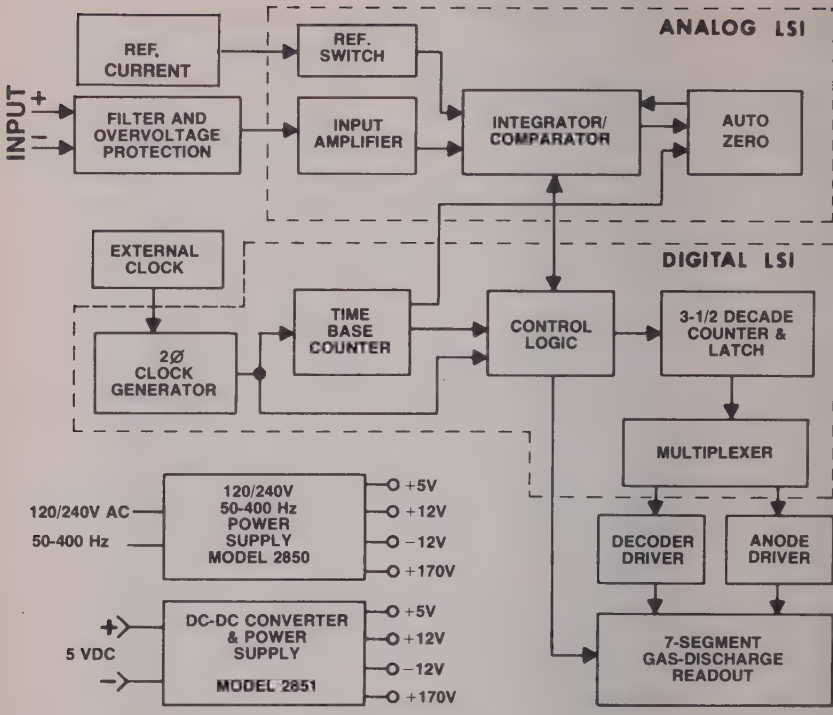

Figure 5-1. Models 2850 and 2851, Overall Block Diagram

5.2.3 Measurement Interval

The input voltage is now connected to the input amplifier. The integrator/comparator senses an imbalance which the control logic attempts to equalize by pulsing the Reference Current. During the equalization process, the counter/latch accumulates a count proportional to the magnitude of the input voltage.

5.2.4 Display

At the end of the measurement interval, the latch is up-dated and the counter is cleared. The multiplexer routes the information from

the latches into the BCD and digit outputs. The BCD data are decoded into a 7-segment format which are connected to the cathodes of the display. The digit outputs control the annode drivers which select the correct digit. The 7-segment gas-discharge display gives a large, bright, easy to read display.

5.3 POWER SUPPLY CIRCUITS

5.3.1 The circuits for the Model 2850 power supply are shown in Figure 7-1.

5.3.2 Transformer T1 is a dual-primary power transformer. The two primary windings are connected in series for 240 volt and in parallel for 120 volt operation.

5.3.3 There are three secondary windings on transformer T1 which generate proper voltages as required by the circuitry. Rectifiers and regulators convert and regulate the output voltages.

5.3.4 Regulated DC voltages of +12V and −12V are produced by two full-wave rectifiers, followed by two series-type voltage regulators. These regulated voltages are used to supply power to the analog circuits.

5.3.5 A regulated DC voltage of +5V is produced by a full-wave rectifier followed by a series-type regulator. The +5V is used to supply power to all digital integrated circuits.

5.3.6 The 170 VDC power supply has a half-wave rectifier. This voltage operates the gas-discharge readouts. A bleeder resistor is placed across the 170 VDC output for safety reasons.

5.4 MODEL 2851 POWER SUPPLY

5.4.1 A DC-to-DC circuit board is used to convert the 5 VDC supply voltage to the various required circuit voltages of the Model 2851.

5.4.2 All the circuit connections are the same from the secondary of T201 as for T1 of the Model 2850. Circuit operation is also the same as that described for the Model 2850.

SECTION VI

MAINTENANCE

6.1 GENERAL

WARNING

This Instrument contains internal voltages that constitute a SHOCK HAZARD. For repairs or adjustments refer to a Simpson Authorized Service Center.

Models 2850 and 2851 are carefully designed and constructed with high quality components. Through proper care and operation, as outlined in this manual, you can expect a long, useful service life from this Instrument.

6.2 WARRANTY

The Simpson Electric Company warranty policy is printed in the inside back cover of the manual. Read carefully before requesting a warranty repair.

NOTE: For assistance of any kind, including help with the Instrument under warranty, contact your nearest Authorized Service Center for instructions. These are listed on the last pages of the manual. If you wish to contact the factory directly, give full details of the difficulty and include the Instrument Model Number, Serial Number, and date of purchase. Service or shipping instructions will be promptly sent to you. There will be no charge for repair of the Instrument under warranty beyond one-way transportation charges. If an estimate of charges for non-warranty or other service work is required, a maximum charge estimate will be quoted. This charge will not be exceeded without your prior approval.

6.3 SHIPPING

Pack the Instrument carefully and ship it prepaid to the destination indicated. Insure the shipment.

6.4 CASE AND FRONT COVER REMOVAL

WARNING

Remove all power and connections to the Instrument before removing the case or replacing the fuse.

The case and front cover can be removed for maintenance purposes as follows:

a. Disconnect the Instrument from the AC power source (Model 2850) or turn power OFF.

b. Remove the two screws that attach the PC connector to the Instrument (when used) and remove the PC board connector from the rear of the Instrument.

c. Remove the two screws that attach the front cover to the case and pull the PC board assembly forward out of the case.

6.5 NUMERIC DISPLAY

The gas-discharge displays are easily replaced through the use of sockets. However, if replacement is necessary, it should be done by a Simpson Authorized Service Center or at the factory repair facility. Two different type displays are used.

6.6 LINE FUSE REPLACEMENT MODEL 2850 ONLY

The line fuse is located next to the power transformer.

a. Remove the case and front cover as described in paragraph 6.4.

b. Carefully lift the defective fuse from the holder and replace with a type 1/8A, 8AG, normal-blow fuse, or equivalent (refer to Table 7-3 for part number when ordering).

c. Replace the case and front cover.

6.7 RANGE CALIBRATION

6.7.1 The Model 2850 and 2851 have been precisely calibrated at the factory. Use of quality components and precision circuitry eliminates the need for frequent recalibration. If recalibration is required, return the Instrument to a Simpson Authorized Service Center, or the factory.

6.8 PREVENTIVE MAINTENANCE

6.8.1 Daily Care

The case and front cover are made of a plastic material having good physical resistance and temperature characteristics. To maintain the Instrument in good condition, observe the following:

a. Immediately clean all spilled materials from the Instrument and wipe dry. If the spillage is corrosive, use a suitable cleaner to neutralize the corrosive action during cleaning.

b. Whenever possible, avoid prolonged exposure or usage in areas which are subject to temperature and humidity extremes, vibration or mechanical shock, dust or corrosive fumes, or strong electrical or electromagnetic interference.

6.8.2 Monthly Care

Verify Instrument accuracy by performing operational checks using known value sources. If repair is necessary, contact the nearest Authorized Simpson Service Center or the factory.

6.8.3 Annual Care

It is recommended that the Instrument be returned annually to a Simpson Authorized Service Center or Factory for a complete overall check, adjustment and calibration.

6.8.4 Storage

When the Instrument is not in use, store it in a location free from temperature extremes, dust, corrosive fumes, and mechanical vibration or shock.

6.9 TROUBLESHOOTING

6.9.1 If the Instrument does not operate satisfactorily, check the following items before attempting maintenance on the Instrument.

a. Check the power connections.

b. Check that the PC board connector is wired correctly and inserted properly (see Figures 4-1 and 4-2). Make sure that all contacts on the printed circuit board are clean.

c. Check that the value being measured is within the rating of the Instrument.

d. Ensure that the AC power source (Model 2830) is within the Instrument specifications, and free from excessive fluctuations and/or transients. Check the 5 VDC source for Model 2851. The source must deliver at least 700 mA for proper operation.

e. Ensure that the environment in which the Instrument is being used is within the Instrument specifications.

f. Inspect the device being measured and the measurement test set-up to ensure that proper shielding and grounding techniques have been used. Also check that the Instrument is not affecting the circuit being measured and that the measurement is valid. For example, DC accuracy can be affected by transients, or unwanted AC and DC signals introduced by electrostatic, electromagnetic, or capacitive pickup, or existing as part of the signal.

g. If it appears that there is no power, check the AC line fuse, refer to paragraph 6.6 for line fuse replacement.

6.9.2 If the steps taken in paragraphs 6.9 do not yield satisfactory results, ship the Instrument to a Simpson Authorized Service Center or the factory for repair.

SECTION VII

ORDERING INFORMATION, SCHEMATIC DIAGRAMS, AND AUTHORIZED SERVICE CENTERS

7.1 GENERAL

Simpson Authorized Service Centers have been established throughout the United States and Canada. To obtain repair or recalibration for any item of Simpson equipment, contact the Authorized Service Center and make arrangements with them for the service you require. A list of the Authorized Service Centers is included on the last pages of this manual.

Table 7-1. Items Supplied With the Instrument

Quantity	Description	Part No.
1	Mounting Bracket	10-863122
1	Operator's Manual	5-117719

Table 7-2. Optional Mounting Hardware

Quantity	Description	Part No.
1	Panel adapter, DIN, IEC	22992
1	Panel adapter, Domestic type	22993
1	Mounting Bracket, Rear (DIN, IEC)	22991
1	Connector, PC Board	22990

Table 7-3. Replacement Parts List

Reference Symbol	Description	Part No.
C1	Capacitor, .033 μF, 20%, 100V	5-117732
C2, C3	Capacitor, .022 μF, 20%, 100V	5-116188
C4, C12, C13	Capacitor, .01 μF, 20%, 50V Ceramic	5-113215
C5	Capacitor, Trimmer, 5.5-60 pF, 100V	5-116235
C6	Capacitor, .1 μF, 20%, 100V	5-113612
C7	Capacitor, .0022 μF, 5%, 100V	5-117201
C8	2850, 10 μF, 50%, 200V	5-117736
C8	2851, 1 μF, 75%, 400V	5-118060
C9, C10	Capacitor, 100 μF, −10 to +50%, 25V	5-117737
C11	Capacitor, 220 μF, 10V	5-117738
C14	Capacitor, 15 μF, 16V	5-115534
C101, C102	Capacitor, 100 pF, 10%, 500V, Ceramic	5-113021
D1	Diode, Silicon, 1N4004	5-116324
D2, D3	Diode, Silicon, 1N4001	5-113200
D4	Diode, Silicon, Bridge Rect. W005	5-115945
D5, D6, D7	Diode, Silicon, 1N914	5-112004
DS1	Readout, 7-Segment, 2 digit, SP352	5-117151
DS2	Readout, 7-Segment, 1-1/2 digit, SP351	5-117727
F1	Fuse, 1/8A, 8AG Normal Blow	5-116378
IC1	Integrated Circuit, Analog A/D Converter, LD111	5-117724
IC2	Integrated Circuit, Digital A/D Converter, LD110	5-117723
IC3	Integrated Circuit, NE555	5-117150
IC101	Integrated Circuit, 7-Segment High Voltage Decoder/Driver LM8884A	5-117148
R1	Depends on Range and Function (see Table 7-4)	
R2	Depends on Range and Function (see Table 7-4)	
R3	Resistor, 470kΩ, ±10%, 1/2W	1-114227
R4	Resistor, 560kΩ, ±10%, 1/4W	5-114984
R5,R41,R16 R21, R24 R27, R30	Resistor, 100kΩ, 10%, 1/4W	5-115514

R6	Resistor, 104kΩ, 1%, 1/4W	5-117712
R7	Potentiometer, 10kΩ, Cermet	5-117718
R8	Depends on Range and Function (see Table 7-4)	
R9	Resistor, 130kΩ, 5%, 1/4W	5-117709
R10	Resistor, 402Ω, 1%, 1/4W	5-116712
R37	Potentiometer, 2.2kΩ, Carbon	5-117717
R11	Resistor, 33kΩ, 10%, 1/4W	5-113875
R12	Resistor, 3kΩ, 5%, 1/4W	5-117952
R13	Resistor, 12kΩ, 5%, 1/4W	5-117194
R19	Resistor, 56kΩ, 10%, 1/4W	5-115513
R26, R29 R18,R20,R23	Resistor, 15kΩ, 10%, 1/4W	5-113621
R22, R25, R28, R31	Resistor, 1kΩ, 10%, 1/4W	5-113871
R32	Resistor, 10kΩ, 10%, 1/4W	5-113624
R33	Resistor, 470kΩ, 5%, 1/4W	5-114983
R34	Resistor, 2.2MΩ, 10%, 1/4W	5-115441
R35	Resistor, 820Ω, 5%, 1/4W	5-117186
R36	Resistor, 5.1kΩ, 5%, 1/4W	5-117714
R38	Resistor, 6.2kΩ, 5%, 1/4W	5-117716
R15	Resistor, 39kΩ, 10%, 1/4W	5-114979
R17	Resistor, 22kΩ, 10%, 1/4W	5-113623
R39	Resistor, 470Ω, 10%, 1/4W	5-116093
R40	Resistor, 150Ω, 10%, 1/4W	5-115510
R101	Resistor, 4.7kΩ, 10%, 1/4W	5-113873
R102	Resistor, 75kΩ, 10%, 1/4W	5-115437
ZD1	Diode, Zener, 9.1V, 1N757	5-117728
ZD2	Diode, Zener, 9V, 1N937	5-117729
ZD3	Diode, Zener, 6.8V, 1N754	5-116323
ZD4	Diode, Zener 13V, 1N5243	5-117730
ZD5	Diode, Zener, 5.6V, 1N752A	5-111638
	Bezel, Molded Assembly	10-863086
	Mounting Hardware	10-863122
	Manual	5-117719
Q1, Q2, Q15, Q18	Transistor, Silicon, NPN 2N4123	5-115931

Q3, Q4, Q5, Q6, Q8, Q10, Q12	Transistor, High Voltage, NPN, DTN203	5-117722
Q7, Q9, Q11, Q13	Transistor, High Voltage, PNP DTP206	5-117721
Q14	Transistor, Silicon NPN, GET5306	5-115938
Q16	Transistor, Silicon, NPN 2N5815	5-117720
Q17	Transistor, Silicon, PNP D40D1	5-115479
T1	Transformer, Power	5-117740

ADDITIONAL PARTS FOR 2851 ONLY

Q201, 202	Transistor, NPN D42C2N	5-117956
R202, 203	Resistor, 270Ω, 10%, 1/4W	5-114969
R201, 204	Resistor, 330Ω, 10%, 1/4W	5-114970
C201, 202	Capacitor, .1 μF, 100V	5-113883
C203	Capacitor, 100 μF, 25V	5-117737
C204	Capacitor, .05 μF, 600V	5-114782
T201	Transformer, DC-DC	5-117930

Table 7-4. Resistance Values for R1, R2 and R8

Range	R1	Part No.	R2	Part No.	R8	Part No.
20μA	Jumper	—	10kΩ	5-113631	10kΩ	5-113631
200μA	Jumper	—	1kΩ	5-115490	10kΩ	5-113631
2mA	Jumper	—	100Ω	5-115949	10kΩ	5-113631
20mA	Jumper	—	10Ω	5-115487	10kΩ	5-113631
200mA	Jumper	—	1Ω	5-116140	10kΩ	5-113631
200mV	Jumper	—	Open	—	10kΩ	5-113631
2V	Jumper	—	Open	—	100kΩ	5-117711
20V	9.9MΩ	5-117713	100kΩ	5-117711	10kΩ	5-113631
200V	9.9MΩ	5-117713	100kΩ	5-117711	100kΩ	5-117711

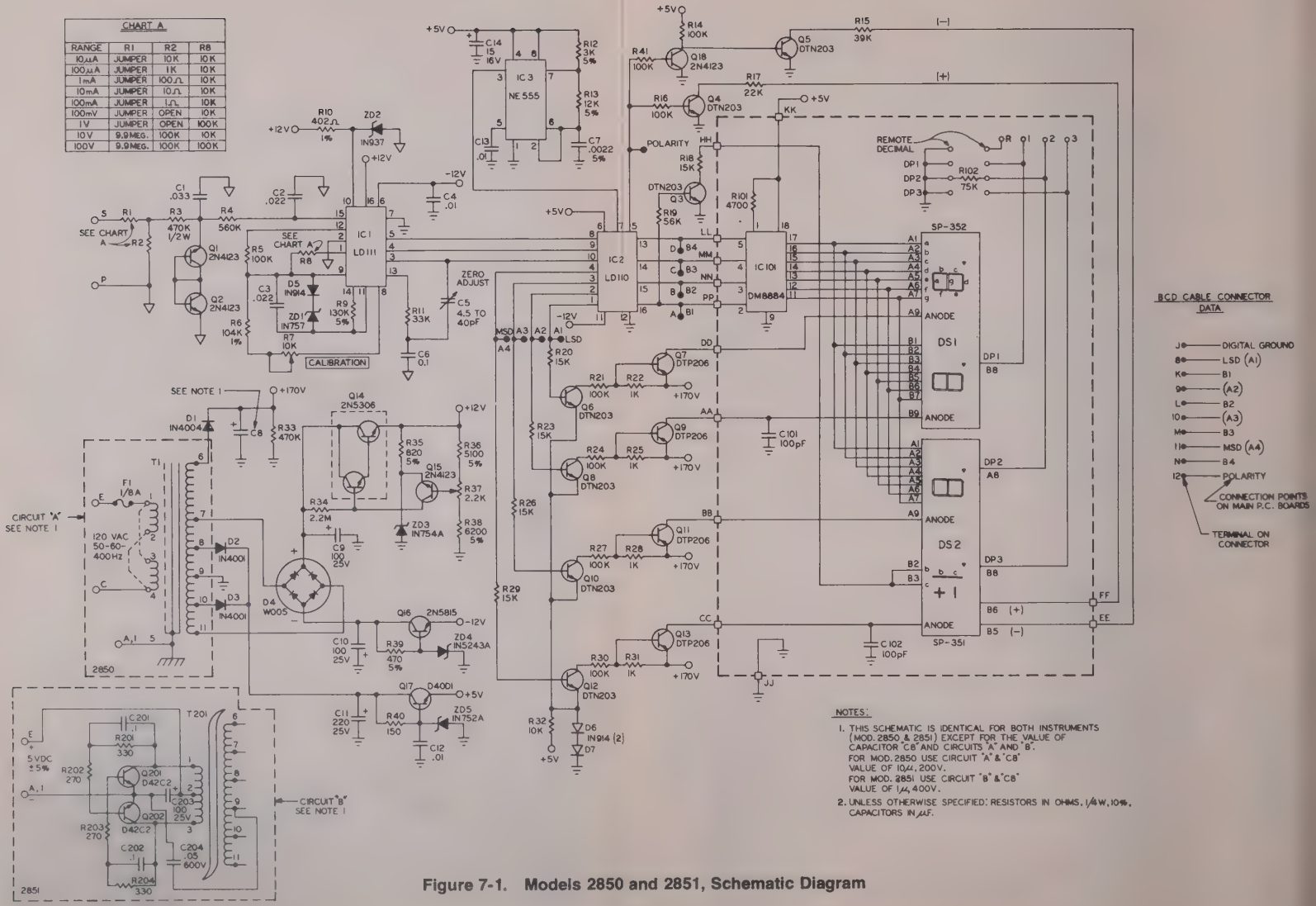
CHART A
RANGE | R1 | R2 | R8
10 µA | JUMPER | 10K | 10K
100 µA | JUMPER | 1K | 10K
1 mA | JUMPER | 100 Ω | 10K
10 mA | JUMPER | 10 Ω | 10K
100 mA | JUMPER | 1 Ω | 10K
100 mV | JUMPER | OPEN | 10K
1 V | JUMPER | OPEN | 100K
10 V | 9.9MEG. | 100K | 10K
100 V | 9.9MEG. | 100K | 100K
SEE CHART A
CALIBRATION
ZERO ADJUST
IC 3 NE 555
IC 1 LD111
IC 2 LD110
IC 101 DM8884
SP-352
SP-351
DS1
DS2
POLARITY
REMOTE DECIMAL
BCD CABLE CONNECTOR DATA
DIGITAL GROUND
LSD (A1)
B1
(A2)
B2
(A3)
B3
MSD (A4)
B4
POLARITY
CONNECTION POINTS ON MAIN P.C. BOARDS
TERMINAL ON CONNECTOR
CIRCUIT "A" SEE NOTE 1
CIRCUIT "B" SEE NOTE 1
120 VAC 50-60-400Hz
5VDC ±5%
NOTES:
1. THIS SCHEMATIC IS IDENTICAL FOR BOTH INSTRUMENTS (MOD. 2850 & 2851) EXCEPT FOR THE VALUE OF CAPACITOR "C8" AND CIRCUITS "A" AND "B". FOR MOD. 2850 USE CIRCUIT "A" & "C8" VALUE OF 10µ, 200V. FOR MOD. 2851 USE CIRCUIT "B" & "C8" VALUE OF 1µ, 400V.
2. UNLESS OTHERWISE SPECIFIED: RESISTORS IN OHMS, 1/4W, 10%. CAPACITORS IN µF.

Figure 7-1. Models 2850 and 2851, Schematic Diagram

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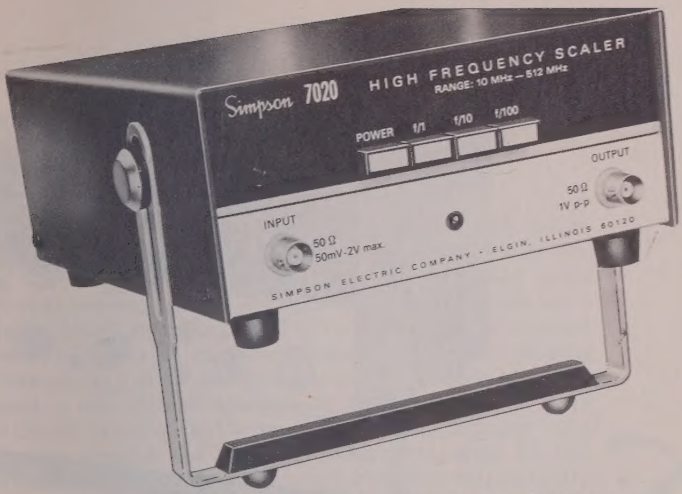
Simpson

ELECTRONIC FREQUENCY COUNTER TIMER
MODEL 7016

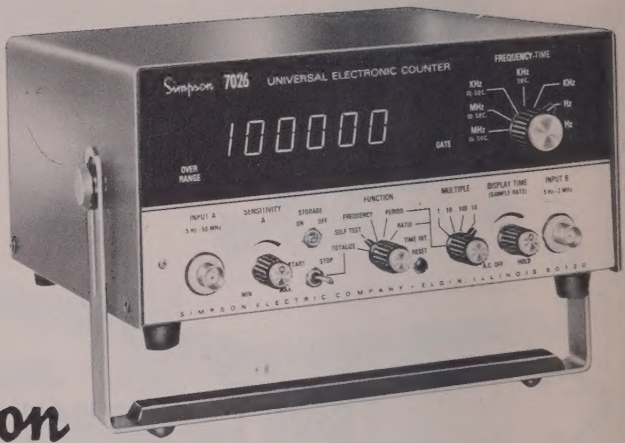
- For measuring frequencies, elapsed time and events.
- Large, highly visible 0.55" planar numerical display.
- Frequencies from 5 Hz to 50 MHz in four ranges.
- Elapsed time from 0.01 sec. to 19999.99 sec.
- Totalizes from 1 to 1999999.
- IC construction assures high reliability, low power dissipation and compact design.
- Other standard features include: display storage selection, automatic decimal point location, variable display time, manual reset, overrange and gate time indications; 1 MEG Ω input impedance, and input overload protection.
- Interfacing with a high frequency prescaler such as the Simpson Model 7020, extends the Model 7016 counting capability to high frequency signals in excess of 500 MHz.
- Model 7016 incorporates 1 ppm internal oscillator accuracy as compared to 10 ppm for the 7016.
- Model 7016B incorporates additional BCD Output.



Simpson HIGH FREQUENCY SCALER

MODEL 7020

- Extends measuring capability of low frequency counters to 512 MHz.
- Interfaces with Simpson Models 7016 and 7026 as well as with most competitive frequency counters.
- Switch-selectable direct frequency divisions of 1, 10 and 100.
- IC construction assures high reliability, low power dissipation and compact design.
- Power: 120/240 VAC $\pm$ 10%, 50-60-400 Hz 6 VA approx.
- Size: 2.5H x 6W x 8"D (63.5 x 152.4 x 203.2 mm),
- Weight: 2.5 lbs. (1.13 kg).



Simpson

UNIVERSAL ELECTRONIC COUNTER
MODEL 7026

- For measuring frequencies, periods, ratios of two frequencies, time intervals and events.
- Large, high-visibility 0.55" planar numerical display.
- Frequencies from 5 Hz to 50 MHz in seven ranges.
- Periods from 100μS to 0.2 sec. (sine wave).
- Multiple periods averaged from 100 nS to 0.2 sec. (sine wave).
- Ratio and multiple ratio of two frequencies.
- Time interval from 100μsec. to 1999999 x 10 sec.
- IC construction assures high reliability, low power dissipation and compact design.
- Other standard features include: display storage selection, automatic decimal point location, variable display time, manual reset, overrange and gate time indications; 1 MEG Ω input impedance, and input overload protection.
- Interfacing with a high frequency prescaler such as the Simpson Model 7020, extends high frequency signals in excess of 500 MHz.

Warranty

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles of equipment manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any instrument or other article of equipment which shall within 90 days after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any instrument or other article of equipment which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

Simpson
INSTRUMENTS THAT STAY ACCURATE

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Quality is the indispensable component of every Simpson instrument . . . . . .